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## ■ Research Profiles

**Lars Olof Björn**

***UV4Plants Association's first honorary member***

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**Figure 5.1:** Lars Olof Björn at the last UV4Growth COST Action meeting at Bled, Slovenia. The meeting where the idea of forming a scientific association was born.

### Introduction

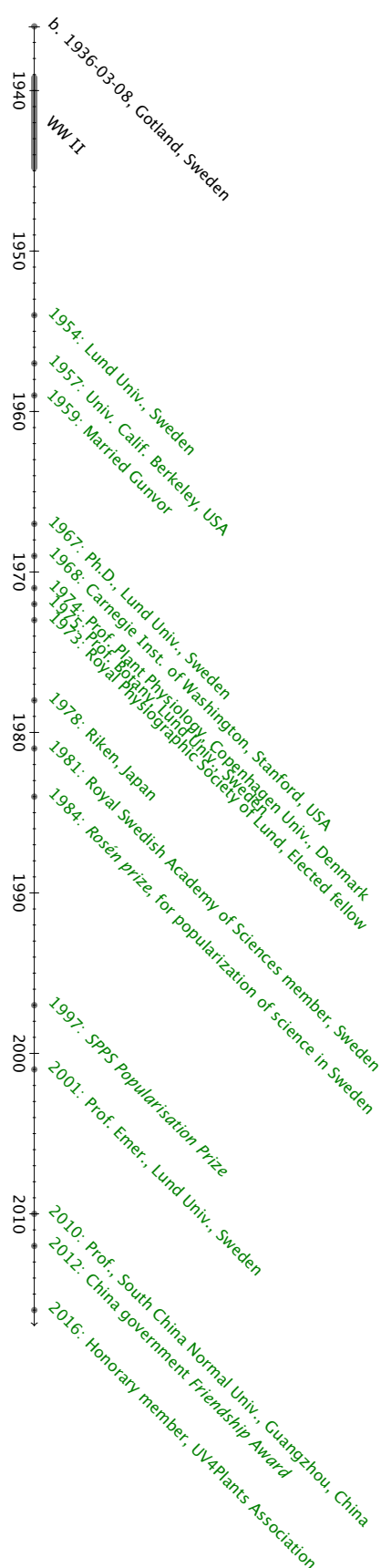
Some time ago I intended to send Lars Olof some specific questions by e-mail to assemble an interview in a questions and answers fashion. However, I first discussed with him through e-mail the broad idea I had for the interview. Next day I received a well organized text matching what I had in mind. So Lars Olof's text became the core of this profile. This article also includes sections contributed by researchers who have collab-

orated with Lars Olof in one way or another. The year 2016 has been a special year for Lars Olof: he turned 80, and formally retired from his professorship at South China Normal University (Guangdong). Of course, this does not mean that Lars Olof has retired from experimental research or lost the curiosity that has been the motor behind his career: he continues doing experiments at home, and actively discusses his ideas with researchers like me and continues to make some of his encyclopedic knowledge available to a wider audience through popular articles and books. This year, at our Association's General Meeting in Pécs, Hungary, Lars Olof was named by unanimous vote the first honorary member of the UV4Plants Association.

### **Lars Olof's life story by Lars Olof Björn**

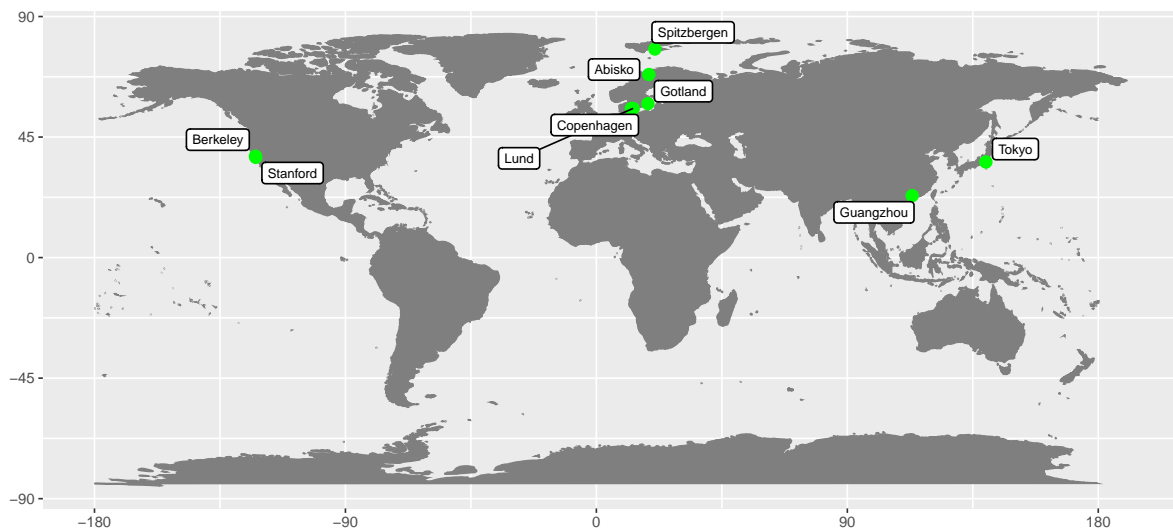
I was born on Gotland in the middle of the Baltic in 1936 and stayed there almost until the end of WW2. The family moved around, so I studied in different schools until I started at Lund university in 1954. After my basic studies I worked as an assistant in the laboratory of Daniel I. Arnon at Berkeley 1957–1958. This financed half-time studies in biochemistry and other subjects at Berkeley, after which I married in 1959 (see Fig. 5.2 for the time line, and Fig. 5.3 for the locations mentioned in the text.).

Figure 5.2: Time line for Lars Olof Björn's life story.



Before I went to America I had done a small photobiology project under the supervision of Hemming Virgin, later professor of plant physiology in Göteborg. He had moved away during my stay in America, but I wanted to continue with photosynthesis, which I had become fascinated with in Arnon's laboratory. However, my professor (Hans Burström) said that after Arnon had discovered photophosphorylation in chloroplasts and Calvin (also at Berkeley) had clarified the path of carbon, there was no more important photosynthesis work to be done, so instead he suggested something else. While I had been away, a guest researcher from Poland, Z. Hejnowicz, had studied protochlorophyll in root tips. I could continue with this. Hejnowicz had written something about it in *Nature*, which I could find myself, said the professor. This was all the guidance I got, as far as I remember, and I worked for several years without any real progress. But I had good talks with Per Halldal (later professor of plant physiology in Umeå and finally in Oslo), who was for some time there, and I think that my situation was really saved by a Japanese guest researcher, Yonezo Suzuki, who was studying isolated wheat roots growing in culture. He had made the observation, a little aside from his real topic, that these wheat roots formed chlorophyll when exposed to blue light, but not when exposed to red light only. I found this interesting, and it became the starting-point for my doctoral dissertation ("The effect of light on the development of root plastids"), which was completed in 1967. So I really had a slow start, taking almost 9 years for my doctoral work, although I was away for 18 months of military service and studied mathematics and physics on the side (read the theory in the evenings during military service, and did the lab work later during summer vacations).

Before I finally completed my Ph.D. I also had an interesting experience working as an assistant for Hans Burström's teacher, Henrik Lundegårdh. This very gifted man,



**Figure 5.3:** Important places in Lars Olof Björn's life.

thought of as the father of Swedish plant physiology as well as plant ecology, was like a professor from a fairy-tale. He had been professor at what is now the Swedish Agricultural University at Ultuna near Uppsala. But he did not like students or paperwork, so he quit and built his own laboratory at the coast. He had constructed the first “flame photometer” for agricultural use and developed a method for analyzing the mineral content of leaves in order to determine the nutritional status of plants, and had earned sufficient money from his patent to allow this “free lancing”. He had enormous self-confidence, and when I arrived the first he said was “Burstrom could at least have sent a docent”, but I think that he appreciated me later, and in fact I had to teach him some electronics, which did not seem to be his strong side. He had been a great designer of laboratory apparatus, and from scratch built a spectrophotometer for in-vivo measurements which people came from far away to study (during my time there a Frenchman (Gaston Ducet) who wanted to do spectroscopy on mitochondria). Lundegårdh was very afraid of radioactivity, and my main role was to measure photophosphorylation using  $^{32}\text{P}$ . Initially I failed, and suspected the water quality, since

the the water came from a metal water still. He did not believe me, but finally he took out a quartz double still from his storage, and after that the phosphorylation was no problem. I was not allowed into his house with the radioactivity, but worked in a shed outside. Since we could not agree on the interpretation of my results I did not appear as coauthor (the same result as for my work with Arnon).

After this, things went a little better. I soon went back to U.S.A. for half a year, this time to the Carnegie Institution of Washington at the Stanford campus. This was a very good time in my life, and I think that I did my best work there, by finding that a single molecule of a certain substance could influence the energy state of a large part of a chloroplast, corresponding to about hundred thousand chlorophyll molecules. Had not Mitchell already formulated his chemiosmotic theory, which I was unaware of, this would really have been great. The director, Stacy French, was very kind and helpful, and although he did not directly participate in the experiments and it was I who initiated the project, built the apparatus etc., in retrospect I regret that I did not include him as coauthor.

I was really interested only in science, so

when back in Lund my good wife Gunvor kept us alive by working as a chemistry teacher and keeping a tight grip of our budget. (When economy and children later permitted, she got her own biology Ph.D.) I never thought of promotions or money or considered the fact that the docent position I had got was time-limited, but one day Hans Burström turned up in my room and said that a professorship in Copenhagen was open for application, and that I ought to apply. I think that this was the second piece of guidance that he gave me, and it was probably because it would look good if somebody from his lab would apply. He was not really interested in my work, neither did he believe, I think, that I would have a chance to get the post. But competition was not so strong, so I got it. Since my oldest child was already in school in Sweden, I chose to keep my home in Lund, and commuted daily to Denmark. It was rather hard, since there was no bridge in those days. I had to travel by car to Malmö, then boat to Copenhagen, then one bus, then transfer to another bus. I had to get up early and came home late.

The next year, however, Hans Burström retired, and I applied for and got his position.

Until then I had conducted much of my life in darkrooms, which was necessary for the study of the light processes that I was interested in. I continued with this for a total of about twenty years, with rather disparate studies of chlorophyll formation, photosynthesis, phytochrome and cyanobacterial pigments. Nothing of this can be said to be important research, but some of it gave me great pleasure and was intellectually stimulating. Especially I remember the pleasure I had in studying the geometry of the phytochrome molecule and the photoinduced rotation of its transition moment, by converting a spectrophotometer into an apparatus for measuring linear dichroism and developing from scratch the rather complex mathematics and computer programs. Gunvor and I had started to prepare for this during a

stay in Kazuo Shibata's lab at "Riken" in Japan, and Gunvor had learned to purify phytochrome using instructions that I had got from Pill Soon Song in Texas. In later experiments I cooperated with Christer Sundqvist (later professor of plant physiology in Göteborg), who had learnt (during a stay at Carnegie) to immobilize phytochrome molecules by attaching them to Sepharose. The computers were primitive in those days, and we had to run the programs overnight. It was exciting to come in the morning and see if everything had worked as it should. Often there was some bug that had turned up late in the run. I think that the experiments were good, but they have had no lasting value since they were superseded by other methods.

After these ca. 20 years in darkrooms there came a change. I had started some simple experiments on effects of ultraviolet radiation on plants with Janet Bornman (later professor in succession in Denmark, New Zealand and Australia). Mats Sonesson, professor of plant ecology in Lund and director of the science academy's research station at Abisko in Lapland had heard of this, and urged me to come to Abisko and set up field experiments concerning UV effects there (Fig. 5.4). The reason was the concern that had started to emerge regarding the thinning of the ozone layer and the concomitant increase in ultraviolet radiation. I was happy to come back to Lapland. My mother was born there, and I had spent time there during my childhood and adolescence. So another 20 years followed, during which I and my wife spent part of the summers at Abisko, and not only did science, but combined science with pleasure and took many walks among the mountains. We also enjoyed meeting other kinds of people during these years. I wish to especially mention the very good doctoral student Ulf Johanson who helped to set up these experiments and worked with them during the coming years, and also helped to set up similar experiments on the island of Spitzbergen





**Figure 5.4:** Lars Olof Björn in Abisko, Sweden, 1992. (P. J. Aphalo)

in the Arctic. I should also mention Terry Callaghan, who succeeded Mats Sonesson as director of the research station. There are not many who know the plant ecology of the Arctic nearly as well as Terry. Another Ph.D. student, Carola Gehrke played an important role in the early Abisko experiments.

But I also had students who were more interested in life in water than on land. When Nils Ekelund (later professor, first at the Mid-Sweden University, and later in Malmö) first turned up and wanted to start work for a Ph.D. I tried to coax him into the Abisko work, but he had scuba diving as a hobby and insisted that he preferred to study the effect of ultraviolet radiation on algae. To supervise his work I got very important help from Donat Häder, and Nils spent some time with him at Erlangen. Nils eventually got his own

UV-effects students.

When I retired in 2001 my post was not renewed, but another one of my (and Winslow Briggs') former doctoral students of photobiology, Susanne Widell, had already been promoted to professor and took over the responsibility for plant physiology, which underwent a major change when all the different biology departments were reorganized to a single super-department of biology. For a few years I tried to become retired, but then gave up and accepted a half-time post as professor in China, which I had been invited to at the initiative of one of a former guest researcher in our lab, Shaoshan Li, who had since advanced in the hierarchy (Fig. 5.5). In China it is enough to be old to be honored, so I got medals both in Beijing and Canton (Guangdong), and was appointed honorary



**Figure 5.5:** Ceremony of appointment as professor of South China Normal University, Guangdong. Lars Olof Björn and the president of South China Normal University, professor Liu.

citizen of Guangzhou. I kept this position for 6 years. I retired from it in May 2016 after having passed the 80 year limit, but am still doing some advising of Chinese doctoral students via e-mail. I am also continuing simple experiments at home, and working on a book on photosynthesis. Contrary to what my professor thought in 1958, there is much that had been discovered about photosynthesis since then.

I have not been as specialized as many others, and do not feel that I have any very deep knowledge about anything. I am rather a generalist. Occasionally I have diverged from the study of plants to bacteria, fungi, birds, vitamin D in human skin. My first biological fascination was insects, which I was introduced to by my father. Looking back I have been very lucky and lived, on the whole, a happy life without worries.

Looking back I am struck by the lack of correlation between what I consider good and mediocre among my publications, and the number of citations that they have got. For in-

stance, what I consider myself as my best paper, the one from Carnegie (1971), has been cited only 41 times in 44 years, while a very simple article from 2009 has got 55 citations in 6 years. Perhaps a comfort for those who think that they have good papers which have not got their share of citations.

### Questions (PJA) and answers (LOB)

**Q** How have human relations among researchers, the “sociology” of science, changed since you were yourself a PhD student until the present day? I would expect that both positive and negative changes have taken place, and maybe not as a continuous trend.

**A** I think that the main change that I have seen is increased cooperation and, to an even greater extent, increased co-authorship. When I started to publish I had in most cases only my own name on the publication, and we were at most 3 authors. Nowadays single-

authored publications are a minority, perhaps reviews forming an exception.

Also, I think that it in general took a longer time than now to complete experimental work. And, of course carrying out calculations and drawing diagrams was more complicated before computers started to be in use.

**Q** My view is that most of the younger generation of biologists tend to think of equipment for measurements as something given, something totally outside their own field. Yourself, as well as myself, have in practice been keen to play with equipment, modify it, and adapt it from other fields, when we have needed to do measurements requiring equipment we could not afford or that was not available. Do you see a change about this type of attitude in recent decades? Does current university education discourage the willingness of young researchers to “tinker” with equipment?

**A** To some extent this is a consequence of the growth of molecular biology. Molecular biologists mostly use ready-made equipment. To some extent it is true also for biology in general, as more and more ready-made equipment has appeared on the market.

**Q** With recent cuts in public funding for research in many Western countries, in particular for non-applied research, do you think that China will become more competitive? Both in science itself, and commercially? Have you seen also a cultural change in the attitudes of Chinese researchers? And how does Chinese culture favour and/or hinder an independent and objective approach to research compared to Western culture?

**A** Yes, China is becoming more competitive, even if the Chinese economy recently has slowed down. I have noticed that more and more Chinese names appear among the authors in international journals, and in many cases the articles published by Chinese are very good. However, it is clear that not always all people listed as authors have really

been involved in the research. And Chinese culture and education, with a tendency to regard authorities as infallible, is not optimal for science.

**Q** If you were nowadays starting a career as a researcher what field of research would you find the most interesting and exciting to pursue?

**A** When after basic studies I was to choose a topic for my doctoral thesis I said to my professor that I wished to continue with photosynthesis (I had already worked as assistant for Daniel Arnon in his studies on photophosphorylation for a year). But my professor said (in 1958) that there would be absolutely nothing more to discover about this process, so I ought to do something else.

I think that at that time my choice would have been good. And I think that photosynthesis is still an exciting field. Alternatives for me today, had I been young today, could have been the origin of life or some branch of microbiology. Or entomology. Insects were my first biological interest, and I still find them very interesting. Perhaps insect orientation, migration and navigation.

## Contributed texts and illustrations

### Janet Bornman

What first comes to mind is probably how well Lars Olof fits the descriptions of Peter Medawar’s assessment in *Pluto’s Republic* (Medawar 1982). Medawar described scientists as “people of very dissimilar temperament doing different things in different ways. Among scientists are collectors, classifiers and compulsive tidiers-up; many are detectives by temperament and many are explorers, some are artists and others artisan. There are poet scientists and philosopher scientists and even a few mystics”. More specifically, Medawar also regarded the work of biologists as “very close to the frontier between bewilderment and understanding. Biology is com-



plex, messy and richly various, like real life, it travels faster nowadays than physics or chemistry (which is just as well because it has much farther to go), and it travels nearer to the ground". Lars Olof certainly unravelled many facets of biology for both scientists and non-scientists.

As for the 'richly various' component of biology, Lars Olof brought scientists from all over the globe to work on projects. Looking back, this opened up the world of science and rewarding people contacts. As a member of the committee that awards the annual Nobel Prize in a variety of disciplines, he also helped in arranging seminar visits to Lund University by some of the Nobel laureates who were either on their way to or from the prize-giving event. I was privileged to meet Paul Crutzen in this way who shared the Nobel Prize in Chemistry with Mario Molina and Sherwood Rowland in 1995 for their work on the formation and degradation of ozone.

Lars Olof can always be relied upon to act or respond quickly. A good example was when I walked into his office at the Department of Plant Physiology one day in 1980 and asked about the possibility of starting a PhD. I walked out a few minutes later with a UV-B radiation project. Although technically a photobiology project, I spent the next 4 years in dark or green light as so many photobiologists do. There were, however, several lighter moments such as in the middle of 'serious' PhD work on UV radiation on plants, I was asked to put some cooled frogs into special spectrophotometer cuvettes to measure, if I recall correctly, their light reflectance.

An excerpt from Lars Olof's poetic recollections of the above, read out at my PhD dissertation:

*One day she gave me a ring on the phone,  
And she told me "I'm feeling so very  
alone,  
I'm so bored in my house.  
Please take me as a student!  
I'm truly tidy and prudent.  
I will work hard and fast*

*and will leave as the last  
when the work-day is past"*

*I answered after a while that "I will,  
because I have a gap in my spectrum to  
fill.*

*I have people working from far-red to  
blue,  
but now I need you,  
because I want to  
use more energetic quanta"*

### Éva Hideg

"Well, that's what I think. But be sure to ask Lars Olof as well." -- ever helpful colleagues usually ended scientific discussions with these words at Lund University's Department of Plant Physiology during my visit in the 90's.

One just had to find Lars Olof. He spent a lot of time at the department; it was just the heisenbergian problem of location. He could be downstairs in the greenhouse, having to check some plants urgently, despite the "insecticide-do-not-enter" sign posted by the gardener. Ducking under the ladder placed there to block the entrance and bearing the above sign was simple enough. Or maybe he was in his dark room, fiddling with the ultrasensitive photon counter that he built and placed inside a wooden box rather than the usual metallic one. By this simple and ingenious design he prevented the plethora of problems arising from electrostatic interactions between metal shielding and wiring that other labs spent millions of yen to solve (usually by building another metal box around the first one). He could also be upstairs in his office, with the huge pyramid pile of journals, reprints and manuscripts which stayed on top of the large conference table defying physics and were kept in an organised chaos only Lars Olof mastered. Or anywhere between basement and top floor, stopping by at another department, seeing old friends or former students, curious how their experiments were going. Soon enough, you heard him. Never using the elevator, just sort

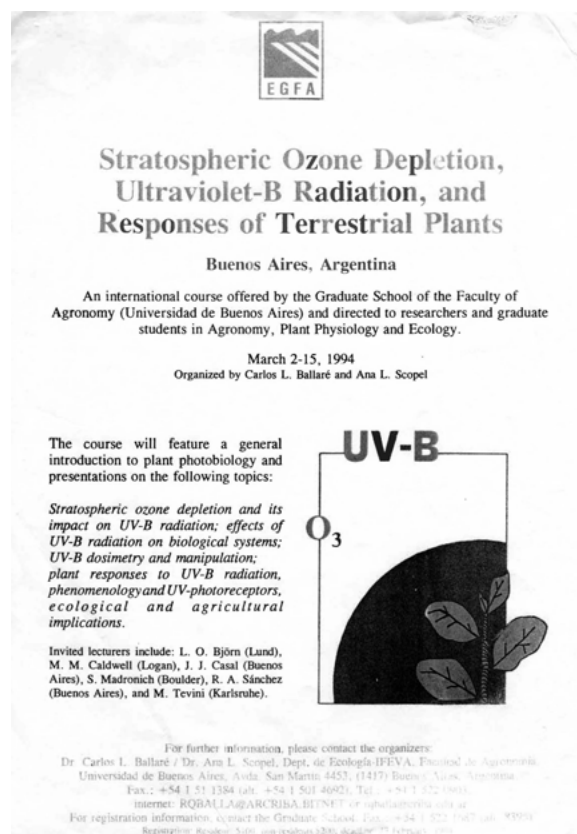
of running and jumping downstairs, skipping stairs. Bump, bump, bump. As far as he knew, that was the only way of coming downstairs, although sometimes he may have felt that there really was another way, as he advised people against following suit.

Having found him, Lars Olof was always ready to discuss. At the department in, or during the too short period we spent in the same lab in Japan, later on when we met at conferences or simply via emails. I'm feeling incredibly and undeservedly lucky that I know him in person. He may disappoint people expecting the unquestionable dogmatic truth from a professor, as his wisdom usually comes in questions. Because Lars Olof makes you think and think again from another viewpoint. And when you are about to leave feeling satisfied and enlightened, he lets you go saying that he may be wrong, so be sure to think about it some more. Although unanimously liked by students, his questions at PhD viva were often dreaded. This is because unlike teachers who formulate exam-like questions on such occasions, Lars Olof tends to ask you ones he does not know how to answer. Well, at least not at that particular moment. Later on, he'll ask himself again for sure.

Curiosity, Humor, Kindness, Sharing, Wisdom -- five key words to summarize. Thank you, Lars Olof.

### Pedro J. Aphalo

Many of us owe Prof. Lars Olof Björn a lot. He generously used and uses time to help others, both within the scientific community and outside it. He is also generous in sharing new ideas and encouraging and helping others explore new avenues. I cannot imagine other researchers thinking of him as a competitor. I met Lars Olof for the first time in Buenos Aires in March 1994, and we have kept in contact since then. I remember three events that were particularly significant for me: being invited by Lars Olof to give a sem-



**Figure 5.6:** Announcement of the UV-B course at the Graduate School of the Faculty of Agronomy, University of Buenos Aires, 1994.

inar in Lund, Lars Olof turning up in a visit to Joensuu in 1996 with a big wooden box, and listening to his talk at the SPPS meeting in Uppsala. We met for the first time when a UNEP meeting was held in Buenos Aires, and Carlos Ballaré organized an intensive course on UV-B photobiology taking advantage of the presence of visitors willing to teach (Fig. 5.6). On one evening we had dinner at the Larreta Restaurant in the Belgrano neighbourhood. Janet Bornman, Carlos Ballaré, Ana Scopel, my wife Tarja Lehto and our daughter Rosa (in a pram) also participated in the dinner.

I probably mentioned before a planned visit by Lars Olof's to Joensuu (Eastern Finland) my worries about the calibration of our then new Macam spectroradiometer. Because of this, he just turned up with his Deuterium

calibration lamp as an additional piece of luggage weighing several kilograms, carrying it all the way from Lund.

Soon after, in 1997, I listened to Lars Olof give a plenary talk at the SPPS congress in Ultuna (Uppsala), Sweden. The talk was linked to a prize Lars Olof had received from SPPS for his efforts in the popularization of science. That talk was eye-opening for me, not so much from the scientific knowledge point of view but rather from what drives Lars Olof into doing scientific research. At a time when tough competition among researchers was becoming the norm, an approach I never felt comfortable with, Lars Olof's talk provided me with a successful alternative model that I could comfortably subscribe to. And this spirit was always present in him, willing to help with a student-exchange EU application with Latin-American partners that I was coordinating, being the opponent of Tania de la Rosa, the first PhD student I supervised, and of course being a key contributor to the *Beyond the Visible* handbook, both scientifically and with his encouragement and example of getting things done.

I have also had the pleasure of meeting Gunvor and Tesla. I have enjoyed the hospitality of Gunvor and Lars Olof, both in Lund and in Abisko, and learnt something new almost each time I have chatted (in person or remotely) with Lars Olof. Thank you, Lars Olof, and let's keep doing things together!

## Highlighted publications (PJA)

It is difficult to make a selection of publications to showcase Lars Olof Björn's broad interests, except for the book edited and partly written by him: *Photobiology: the science of light and life* (Björn 2015), which is already at its third edition. When selecting the remaining publications I include in this section I did not look at impact factors. I think what best describes Lars Olof's publications are "lateral thinking" and "ingenuity". *Lateral thinking* is solving problems through an indirect and

creative approach, using reasoning that is not immediately obvious and involving ideas that may not be obtainable by using only traditional step-by-step logic. Ingenuity is the quality of being clever, original, and inventive. I limit myself to scientific publications and textbooks, as the huge contribution of Lars Olof to the popularization of science in Sweden is described by Åke Strid in a separate article on page 29.

## Books

*Light and Life* (Björn 1977).

*Environmental UV Photobiology* (Young et al. 1993).

*Beyond the Visible: A handbook of best practice in plant UV photobiology* (Aphalo et al. 2012).

*Photobiology: the science of light and life* (Björn 2015) and two earlier editions.

## Broad perspective

"Technical discussion I - underwater light measurement and light absorption by algae" (Björn et al. 1996).

"Viability of lichen photobionts after passing through the digestive tract of a land snail" (Fröberg et al. 2001).

"Vitamin D synthesis may be independent of skin pigmentation only with UV of short wavelength" (Björn 2010).

"Comment on 'Catalytic Efficiency of a Photoenzyme-An Adaptation to Natural Light Conditions' by J. Popp et al." (Björn 2013).

"Thermal emissivity of avian eggshells" (Björn et al. 2016).

## Ingenious methods

"Measurement of light gradients and spectral regime in plant tissue with a fiber optic probe" (Vogelmann and Björn 1984).

"Estimation of fluence rate from irradiance measurements with a cosine-corrected sensor" (Björn 1995b).



**Figure 5.7:** Some of the books edited and/or written by Lars Olof Björn

“Effect of back reactions in the S-cycle on photosynthesis in very weak light” (Björn 1995a).

“Time-resolved studies of light propagation in *Crassula* and *Phaseolus* leaves” (Johansson et al. 1999).

### Demonstrations used in teaching

“Teaching about photosynthesis with simple equipment: analysis of light-induced changes in fluorescence and reflectance of plant leaves” (Björn and Li 2013).

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